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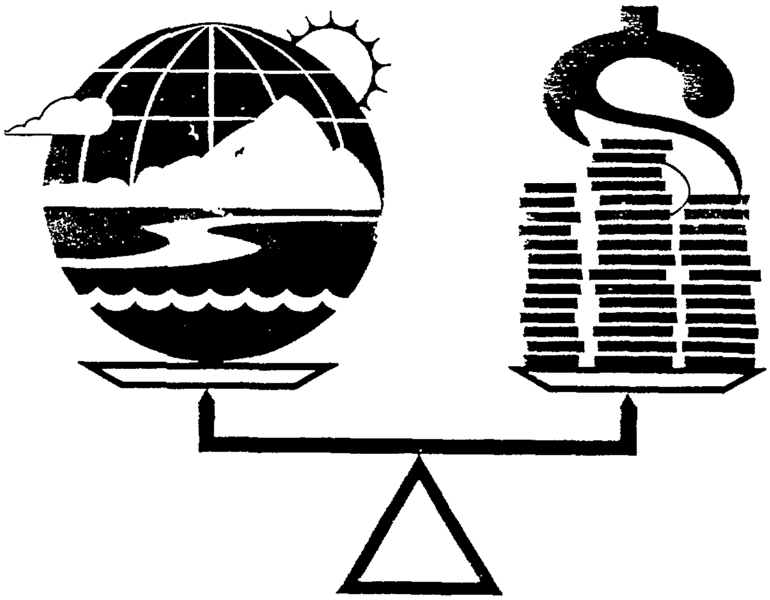
A Model Estimating the Economic Impacts of Current Levels of Acidification on Recreational Fishing in the Adirondack Mountains



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A MODEL ESTIMATING THE ECONOMIC IMPACTS OF CURRENT LEVELS OF ACIDIFICATION ON RECREATIONAL FISHING IN THE ADIRONDACK MOUNTAINS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

(continued)

LIST OF FIGURES

ABSTRACT

The purpose of this project was to estimate the parameters of an economic model that can be combined with information on the current extent of fresh water acidification to produce economic estimates of damages in the Adirondack Mountains of New York State. One traditional approach for estimating the economic value of recreational sites has been to use the travel and on-site costs incurred by visitors as proxy measures of the price paid to use that site. Early travel costs studies focused on changes in the supply of sites, i.e., the addition of a new site or the loss of an existing site. However, the estimation problem faced by this project is different. Acidification not only changes the number of sites available for fishing, but also changes important characteristics of fishing sites. As there are approximately three thousand lakes and ponds in the Adirondack Ecological Zone, a lake by lake analysis was not possible. Instead, each site was viewed as a geographic area containing a number of lakes. Sites were characterized by the number of lakes they contained with certain characteristics. Possible site characteristics include the number of acres of cold water, two story, or warm water lakes. In this framework, acidification could change the area of cold water lakes able to support fish populations. The estimation problem is to determine how a change in these site characteristics will affect the value of a site as a recreational fishery. Both a site characteristics based travel cost model and a simpler participation model were used to obtain estimates of the use values of recreational fishing in Adirondack lakes and the reduction in use values due to acidification were also estimated. The estimates of damages resulting in current levels of acidification ranged from approximately $1 million to $12 million. It should be emphasized that travel cost models are only able to estimate use values. Reviews of the possible magnitude of non-use values indicates that non-use values may be larger than use values.

1.0 INTRODUCTION

The purpose of this project is to estimate the parameters of an economic model that can be combined with information on the extent of the current effects of fresh water acidification to produce economic estimates of damages. A travel cost model is applied to fishing sites in the Adirondack Mountains of New York State. A travel cost model uses information on travel costs to develop estimates of the value of that site; however, these models only estimate a portion of the total benefits derived from the aquatic resources available at each site. The economic value of a site is a combination of both use and non-use values. A travel cost model only estimates use values. Estimates of non-use values must be obtained from other methods. Reviews of the possible magnitude of non-use values indicate that non-use values may be larger than use values.[1]

The Adirondack Mountain region was selected for this study because of the availability of survey data relating current levels of acidification to the presence or absence of desirable gamefish populations. Acidic deposition is commonly viewed as a regional problem since large areas in the eastern United States and Canada have elevated levels of deposition (National Research Council, 1983). However, from the perspective of damages to fish populations, the fresh water effects of current levels of acidic deposition are expected to occur in narrower geographic areas. Two factors must interact before fish populations will experience adverse effects from acidic deposition - first, the watersheds must be exposed to elevated levels of acidic deposition; and secondly, the watersheds must be sensitive to the increased hydrogen ion deposition (U.S. EPA, 1983). Even though broad regions are exposed to elevated levels of acidic deposition, sensitive lakes and streams are grouped into smaller areas. The regions containing sensitive lakes in New York are essentially limited to the Adirondack and Catskill Mountains, and the Hudson Highlands (U.S. EPA, 1985). Within these regions, the waters that tend to be the most susceptible to acidification effects are the high altitude brook trout ponds and streams (Schofield, 1982).

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[1] See Fisher and Raucher (1983) for a review of this material.

Past analyses of user damages to recreational fishing caused by acidification (Crocker et al., 1981 and Menz and Mullen, 1982) have estimated economic losses to be extremely small. The primary reason for these findings is the small number of affected ponds relative to the total lake and pond acreage in the Adirondack Mountains. The rationale for this result is that, even though there are some lakes that are being affected by acid deposition, the number of anthropogenically acidified lakes is not large enough to substantially affect the available fishing opportunities. Another way of stating this is that there are enough substitute lakes available for fishing, so that the loss of a limited number of gamefish populations does not have a large effect on the overall recreational use value of the aquatic resource in the Adirondack Mountains. In a recent study, Peterson (1983) estimated that a decrease in sulfate deposition of 25 percent would increase gamefish habitat in the sensitive Adirondack Mountains and Catskill-Hudson Highlands by only five percent. Assuming that only waters in the Adirondacks and Catskills are affected at current deposition levels and extrapolating to New York State, the statewide increase in gamefish habitat resulting from a 25 percent decrease in sulfate deposition is found to be less than one percent. The general order of magnitude of these estimates indicates that if all fishing sites are considered substitutes, estimates of damages likely will be small.

Because previous estimates of damages have been small; this study has been framed to, where possible, provide an upper-bound of consumer surplus damages related to acidification in the Adirondack Mountains. This approach was followed in order to provide policy makers and economists with estimates that indicate the largest probable loss of recreational fishing use values attributable to acidification. Results, presented in Chapter 5, indicate that consumer surplus losses associated with acidification are small. Because the analysis used assumptions that biased the calculations to provide an upper-bound damage estimate, the size of the consumer surplus losses supports the interpretation that recreational use value losses associated with acidification of ponds and lakes in the Adirondack Mountains are relatively small. Again, it is important to recognize that use values are only a portion of the overall value of an aquatic resource.

One issue of importance to the damage assessment that was not adequately addressed in this project is whether the sensitive, threatened lakes constitute a unique resource. Even though the area of threatened lakes is a small fraction of all fishable waters, it may represent a unique resource for which other fishing sites are less than perfect substitutes. In particular, the threatened lakes are largely small, high altitude book trout ponds. These ponds may provide a relatively unique recreation experience. Some of these lakes must be hiked to, and offer more of a combined wilderness/fishing experience than do other fishing sites. A number of these high altitude ponds have already been acidified or are in danger of acidification at current deposition rates (Colquhoun et al., 1984). While these ponds make up only a small portion of total fishable acreage, they may have a disproportionately high value to, at least, some recreationists.

A traditional approach for estimating the economic value of recreational sites has been to use the travel and on-site costs incurred by visitors as proxy measures of the price paid to use that site. Early travel costs studies focused on changes in the supply of sites, i.e., the addition of a new site or the loss of an existing site. However, the estimation problem faced by this project is different. Acidification not only changes the number of sites available for fishing, but also changes important characteristics of fishing sites. As there are approximately three thousand lakes and ponds in the Adirondack Ecological Zone, a lake by lake analysis was not possible. Instead, each site was viewed as a geographic area containing a number of lakes. Sites were characterized by the number of lakes they contained with certain characteristics. Possible site characteristics include the number of acres of cold water, two story, or warm water lakes. In this framework, acidification could change the area of cold water lakes able to support fish populations. The estimation problem is to determine how a change in these site characteristics will affect the value of that site as a recreational fishery.

Two data sets were identified that contain data useful for an analysis of Adirondack lakes - the New York Anglers' Survey and the Adirondack Ponded Waters Survey. The New York Anglers Survey contains data on fishing activity throughout the state; however, the Adirondack Ponded Waters Survey only contains data on lakes and streams in the Adirondack Ecological Zone. As a result, the geographic scope of the study was necessarily limited to this area. This may not pose a significant problem for a national assessment of damages, since documented damages to recreational fisheries at current levels of deposition have largely been limited to the Adirondack Mountain region. Lakes and streams in other regions of the U.S. are sensitive to acidic deposition and may have suffered some damage. Nevertheless, at the current level of acidification most documented effects on recreational fisheries in the United States are occurring in the Adirondack Mountains.

2.0 INCORPORATING SITE CHARACTERISTICS IN TRAVEL COST MODELS

This chapter will discuss, in general terms, potential approaches to incorporate site characteristics within a multiple site travel cost model. The recent literature contains several approaches for incorporating site characterisitics within a travel-cost framework. Prominent applications incorporating site characteristics into a travel cost model are Vaughan and Russell (1982); Desvousges, Smith and McGivney (1983); Morey (1981, 1985); Greig (1983); and Brown and Mendelsohn (1984). This literature includes several diverse approaches, each with certain strengths and weaknesses. The use of site characteristics in travel cost models is a recent development. As a result, new applications and techniques are currently being researched.

The problem of incorporating site characteristics within a travel cost model can be illustrated using a conventional Burt and Brewer (1971) type travel cost model. This “conventional” travel cost model estimates a separate demand equation for each fishing site. These demand functions for "n" fishing sites are shown below.

$$\text{Site 1 equation: } V_{1q} = B_{10} + B_{11} P_{11} + B_{12} P_{12} + \ldots + B_{1q} P_{1q} + C_{1j} S_{qj} + U \qquad (2\text{-}1)$$

$$\vdots$$

$$\text{Site n equation: } V_{nq} = B_{no} + B_{n1} P_{n1} + B_{n2} P_{n2} + \ldots + B_{nq} P_{nq} + C_{nj} S_{qj} + U$$

where:

V_{iq} = the visitation rate to site i from origin q, usually measured in visitors per 10,000 people

P_{iq} = the price of visiting i from origin q in terms of travel and time costs.

B_{iq} = the regression coefficients on the price variables

S_{qj} = socioeconomic variables for origin q

C_{nj} = regression coefficients on socioeconomic variables

U = random term

For example, the data necessary to estimate the site 1 equation are the visitation rate, and the travel costs from each of the q origins to the site. The underlying assumption is that the visitation rates to site 1 will be lower for origins more distant from site 1; that is, as the costs of traveling to site 1 increase the visitation rate will decline.

In this specification, the own price[1] of visiting that site whose demand equation is being estimated is included. Also included are the prices of visiting other substitute fishing sites. This specification takes into account the cost of traveling to substitute fishing sites.

In this conventional model, it is not possible to examine how the characteristics of the site affects the visitor's demand function. The equation for each site is estimated separately. As a result, there can be no variability in the characteristics of just one site. Several different approaches for incorporating site characteristics within a travel cost framework have appeared. in the recent literature. These new methods can be classified into three basic approaches:

1) The varying coefficient travel cost model as characterized by Vaughan and Russell (1982), and Desvousges, Smith and McGivney (1983);

2) The explicit utility function characterized by Morey (1981) and Grieg (1983);

3) The hedonic travel cost model as developed by Brown and Mendelsohn (1984).

A variant of the varying coefficient travel cost model was selected for this application. The characteristics of the available data posed problems for the other two approaches. The appropriateness of these alternative methods for this application are reviewed in Violette (1983).

The varying coefficient travel cost model approach is similar to that used by Vaughan and Russell (1982), and Desvousges, Smith and McGivney (1983). This approach utilizes a two step framework. The first step estimates a separate visitation-travel cost equation

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[1] For example, the own price in the site 1 equation is the price of visiting site 1. Thus, own price effects can be contrasted with substitution effects resulting from the prices of visiting other sites.

for each site. The second step uses the regression coefficients from the step one equations as dependent variables and regresses these coefficients on the site characteristics. To use a simple example, the conventional Burt and Brewer visitation demand function for site "i" is

$$V_{iq} = B_{io} + B_{i1} P_{i2} + \dots + B_{iq} P_{iq} \tag{2-2}$$

where V_{iq} is the visitation rate from origin q to site i and P_{iq} is the travel cost from origin q to site i. Since a separate equation is estimated for each site, there are "i" different estimates of each coefficient. These regression coefficients represent the relationship between travel costs and visits. The variability in the magnitude of the regression coefficients in the different site equations may be due to the relative desirability of the site in terms of the site's characteristics. This can be tested in the second step regressions where the regression coefficients are regressed against the characteristics of each site:

$$\begin{aligned} B_{i0} &= A_{00} + A_{01} Z_{1i} + \dots + A_{0k} Z_{ki} \\ B_{i1} &= A_{10} + A_{11} Z_{1i} + \dots + A_{1k} Z_{ki} \\ &\vdots \\ B_{iq} &= A_{q0} + A_{q1} Z_{1i} + \dots + A_{qk} Z_{ki} \end{aligned} \tag{2-3}$$

where Z_{ki} is the level of the k^{th} characteristic at site i. This two step procedure can be combined into an equivalent one step method by substituting equation 2-3 into equation 2-2 to yield:

$$\begin{aligned} V_{iq} = \; & (A_{00} + A_{01} Z_{1i} + \dots + A_{0k} Z_{ki}) + (A_{10} + A_{11} Z_{1i} + \dots + A_{1k} Z_{ki}) P_{i1} + \dots \\ & + (A_{q0} + A_{q1} Z_{1i} + \dots + A_{qk} Z_{ki}) P_{iq}. \end{aligned} \tag{2-4}$$

Equation 2-4 includes both site characteristics and travel costs as interaction terms. This equation can be estimated using data pooled across sites.

Using ordinary least squares in this two stage procedure will introduce heteroskedasticity into the error term of the second stage regressions. The second stage regression using only one site characteristic as the dependent variable is:

$$B_{i0} = A_{00} + A_{01} Z_1. \qquad (2\text{-}5)$$

The dependent variable B_{i0} is an estimated regression coefficient from the first stage regression; therefore, the error term for the regression shown as equation (2-5) is influenced by the error in the estimated coefficient. This introduces heteroskedasticity in the regression equation error term. Simply stated, if the estimated variance of B_{i0} from the stage 1 regression is large (i.e., B_{i0} is estimated imprecisely) this will influence the error term in the regression shown in equation (2-5). This can be corrected by using generalized least squares (GLS) procedures where the estimated standard errors for the regression coefficient from each site are used as the correcting weights.[2]

The two applications of varying coefficient travel cost model cited previously (Vaughan and Russell, 1982 and Desvousges, et al., 1983) found site characteristics to be significant in the second stage regression equations. The available data and nature of the estimation problem makes this application somewhat different from these previous applications. For example, Vaughan and Russell (1982) used a sample of fee fishing sites in the Northeastern United States. These sites were typically widely dispersed geographically making it unlikely that visitors to one site would have visited another of the sites included in the data set and, even if they had, there was no way to learn this from the data. The Desvousges, et al. (1983) visitation data were obtained from 46 U.S. Army Corps of Engineering recreation sites. Again, these sites were scattered throughout the United States. These applications can be contrasted to the Adirondack region where all of the sites are located in a small region. This results in a visitation data set where many fisherman have visited more than one site.

Because of available data it was desirable to use a variant of this two stage approach. Instead of using ordinary least squares techniques to estimate the coefficients of the first stage site demand equations, a Tobit procedure was used. The Tobit procedure takes full advantage of the available data on individual fishermen. First used in Tobin (1958), it estimates both the probability of an individual visiting a site as well as the number of days the individual will spend at that site, given that a visit is made. Taken

[2] For more detail see G. Saxonhouse (1977).

together, these two estimates can be used to calculate the expected value of days spent at each site for each individual.

The procedure used to incorporate site characteristics within this travel cost model is very similar to the varying coefficient travel cost model as depicted by equations (2-2) and (2-3). The only difference is that the first stage regression coefficients of equation (2-2) are estimated using a Tobit procedure. In the second stage, these regression coefficients are used as the dependent variable and regressed against the site characteristics using a generalized least squares procedure to correct for heteroskedasticity. This procedure will be discussed in more detail in Section 4.3.

3.0 PROJECT DATA

There were two main data sources for this project. These were the 1976-1977 New York Anglers' Survey and the Adirondack Lake and Pond Survey (Ponded Waters Survey). Both data sets were compiled by the New York State Department of Environmental Conservation (NY DEC). Data used in the project are listed in Table 3-1. The site boundaries are shown in Figure 3-1. Names for the sites, based on a prominent water or geographic feature, are shown in Table 3-2. The balance of this section presents a short discussion of the Anglers' survey and the Ponded Waters survey, the procedures used to integrate these two data sets, and the criteria used to define the sites.

3.1 THE NEW YORK ANGLERS' SURVEY, 1976-1977

The New York Anglers' Survey for 1976-1977 is the most recent data source from which information on fishing activity and travel costs can be compiled for the Adirondack Mountains. The Anglers' Survey consisted of a questionnaire mailed to a three percent sample of fishermen licensed in New York State between October 1, 1975 and September 30, 1976. The questionnaire elicited responses about fishing activity in New York State between April 1, 1976 and March 31, 1977. Of the 25,564 questionnaires mailed, 11,721 responses were received.

The questionnaire consisted of three major sections: one - fishing activities, expenditures, and preferences; two - attitudes and opinions; and three - participant background. The first section examined fishing activities, expenditures and preferences. This section collected data on where, for how long, for what species, and by what methods the respondent fished. Data on expenditures per fishing location for that year and for total equipment expenditures were also requested. Questions relating to preferred species, reasons for fishing and what makes a fishing trip successful were included in this section. The attitudes and opinions section of the Anglers' Survey was mainly concerned with New York's fisheries management programs, procedures and regulations.

Table 3-1

Project Data

<u>Angler Specific Data</u>:

- Number of days spent fishing at each site (from Anglers' Survey)
- Years of fishing experience (from Anglers' Survey)
- Annual income (from Anglers' Survey)
- Travel expenditures on gas and oil (from Anglers' Survey)
- Total expenditures in transit to site including gas and oil, food and drink, lodging, and other (from Anglers' Survey)
- Total expenditures at the site including food, lodging, gas and oil, guide fees, and other (from Anglers' Survey)
- Number and species of fish caught (from Anglers' Survey)
- Distance from residence to each site (compiled from regional maps)

<u>Site Characteristic Data</u>:

- Total acreage of ponded waters in that site (from Ponded Waters Survey)
- Acres of private waters in the site (from Ponded Waters Survey)
- Net acreage-total minus private acres (from Ponded Waters Survey)
- Acreage of ponds with warm water fisheries (from Ponded Waters Survey)
- Acreage of ponds with two story fisheries (from Ponded Waters Survey)
- Acreage of cold water and brook trout ponds (from Ponded Waters Survey)
- Total fishing days spent at each site (computed from Anglers' Survey)
- Average daily catch rate (computed from Anglers' Survey)
- Average daily catch rate of brook trout (computed from Anglers' Survey)

Figure 3-1

Mapping of Sites 1 through 24 Used in the Travel Cost Model

(Dotted lines are 15 minute quadrangles, solid lines are either
site boundaries or the boundary to the Adirondack Ecological Zone)

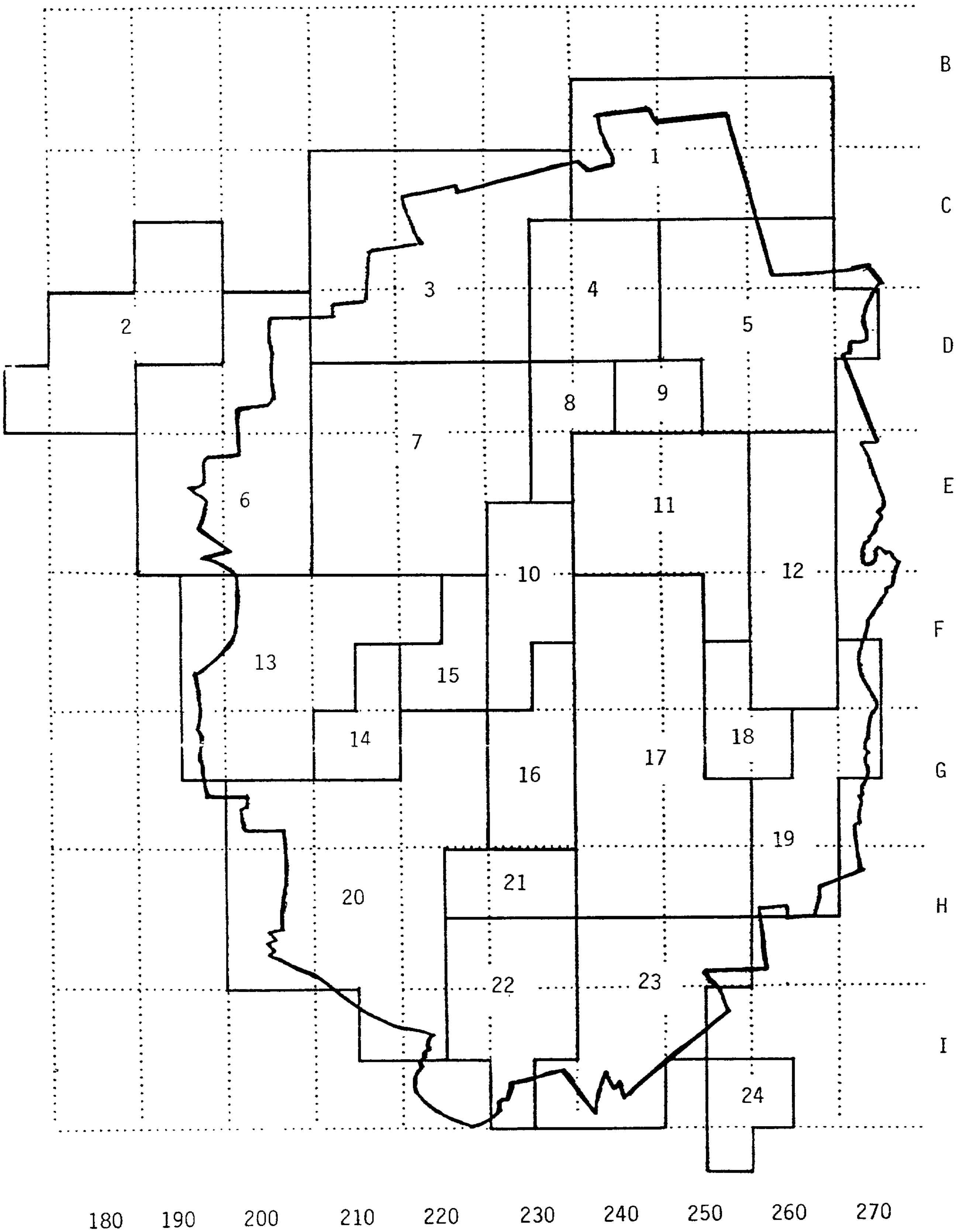

Table 3-2

Fishing Site Names[1]

List of Sites	
1	Chateaugay Lakes
2	Black Lake
3	Lake Ozonia
4	Meacham - St. Regis Lakes
5	Union Falls Pond
6	Lake Bonaparte
7	Cranberry - Tupper Lakes
8	Saranac Lakes
9	Lake Placid
10	Long - Blue Mountain Lakes,
11	Mt. Marcy
12	Paradox Lake
13	Stillwater Reservoir
14	Fulton Chain
15	Raquette Lake
16	Indian Lake
17	Thirteenth Lake
18	Schroon - Brant Lakes
19	Lake George
20	Southwest Corner
21	Piseco - Pleasant Lakes
22	Peck Lake
23	Great Socadanga Lake
24	Saratoga Lake

[1] Site selection was based on several factors including lake and pond geography, accessibility of an area based on the location of paved roads, and the number of observations available for statistical analysis.

The participant background section elicited information on fishing background, whether or not the respondent belonged to a fish and game club, other recreational activities, and household income. A summary of the Anglers' Survey appears in Kretser and Klatt (1981).

Since the 1976-77 Anglers' Survey gathered information on fishing throughout New York State, it was necessary to select only observations on fishing trips to the Adirondack region. Fishing locations in the Anglers' Survey are identified by name of water and county. Relevant observations for this project were chosen by selecting only those fishing locations in Adirondack counties. The counties included are: Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Lewis, Saint Lawrence, Saratoga and Warren. This resulted in data on 3015 individual anglers and 6053 fishing visits.

The 6053 visits by individuals were to 760 different fishing sites, 504 of which were lakes and ponds, the remainder being rivers and streams. Since adequate site characteristic data were available only for lakes and ponds, the effective sample size was further reduced to data on visits to the 504 lake and pond locations.

Data on expenditures in transit to the site and at the site were requested by the Anglers' Survey although not all individuals reported these expenditures. Travel expenditure data were available for 62.3 percent of the 6053 sites, and on-site expenditure data for 57.3 percent of these sites. Expenditures on equipment were also requested, but improperly coded and entered onto the tape, thereby making this data unuseable.

The Anglers' Survey contained no data on distances traveled to each site or rime spent traveling to the site. Distance data was estimated using Zip Codes included in the Anglers' Survey.[1]

Socioeconomic and other respondent background data contained information on household income, date of birth, years of education, and years of fishing. Other questions in this section concerned whether the individual had a preferred species to fish for, whether or not the respondent was a member of a fish and game or other sportsmen's club, and his or her participation in other recreational activities. A number of attitudinal questions were

[1]Given the large number of observations, this was a time consuming task.

also included examining the individual's reasons for fishing, factors important to a successful fishing trip, and limiting factors for respondents who do not fish as often as they would like.

3.2 ADIRONDACK LAKE AND POND SURVEY

Site characteristic data was obtained from the- Adirondack- Lake and Pond Survey[2] (ponded Waters Survey). This data base includes information on 3,506 ponded waters in the Adirondack area. The Ponded Waters Survey is not entirely comprehensive; not every ponded water in the Adirondack area has a complete record. For example, there are only 2,409 pH records in the most recent chemistry survey data for those waters which have been surveyed. Also, not all lakes and ponds are surveyed each year. The most recent survey for a particular pond or lake may have been last year, or it may have been 20 or more years ago. Only 1,217 of the 2,409 pH records date from 1960 to the present. The New York State Department of Environmental Conservation (NY DEC) is continuing to update this data base.

The data in the Adirondack Lake and Pond Survey refers to ponded waters only. Stream fishing is also important in the Adirondacks. There are approximately 5,000 miles of coldwater fishing streams in the Adirondacks, with about 3,500 miles of these open to public fishing (Pfeiffer, 1979). Over 700 miles of warmwater fishing streams also exist, with approximately 480 miles open to public fishing (Pfeiffer, 1979). Unfortunately, stream characteristic data are not as readily available as ponded water data. Miles of streams open to public fishing appears to be available on a county basis, but may be difficult to obtain on a more disaggregated basis. Some acidification data is available for select streams (Colquhoun, et al. 1981, 1984), and a new report on stream acidification in the Adirondacks will be released by the NY DEC in 1985. As a result of the lack of adequate stream and river chemistry and fish population data, this report does not consider potential effects to stream and river fishing opportunity.

The data in the Ponded Waters Tape consisted of seven files, each of which had several record types. Only three of these files were relevent to this project. These files contain

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2 This survey is continually updated. The survey used in this analysis was the version available in February, 1984.

the most recent pond, chemistry and fish data. Waters are identified on each record in each file by their watershed code and pond number. A Fortran program was developed to create a single file in a fixed format containing only the information desired. The Ponded Waters Survey has an entry for the USGS 7-1/2 minute quadrangle location of all but 9 of the 3506 waters listed. As a result, 7-1/2 minute USGS quadrangles were chosen to form the basis of a site.

Of the general site characteristics, surface area and elevation were most commonly available, existing for at least 80 percent of the waters. Shoreline length could be a useful alternative to surface area, and is listed as a variable in the Tape's documentation, but did not exist for any waters. Another potentially useful characteristic listed in the documentation, but for which no data exist, is the distance from a pond or lake to the nearest public road or trail. This accessibility measure could have been quite useful. The public or private ownership classifications may be useful to limit the number of ponds, or surface area in a site, to those open to public use.

The current management class of a water can be useful for determining the different types of fishing opportunities available within a site, and their relative importance. Management classifications in the survey included warm water, two story, cold water and brook trout fishery classifications. Although only 38 percent of the waters were categorized by management class, these waters comprise 87.7 percent of the total measured surface area. Thus, this variable may be used with a reasonable level of confidence.

Two issues surround the relevance of the pH and alkalinity data which are available. One is the fact that much of the data, perhaps a large portion, may be old and thus no longer accurate. Secondly, pH data existed for only 35 percent of measured surface area and alkalinity for only 52 percent. As a result, estimates of the effect of acidification on fishable acreage of ponds made by others were used in this analysis. Other National Acid Precipitation Assessment Program research has calculated the change in fishable acres due to acidification.[3]

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[3] In this report, NAPAP funded work by Dr. Joan Baker at North Carolina State University was used to obtain estimates of how acidification will affect the acreage of water available for fishing.

Since 7-1/2 minute quadrangles were chosen as site components, the data extracted from the. original Ponded Waters tape for each pond or lake needed to be aggregated by quadrangles. Site characteristics were defined in terms of surface area. For a quadrangle containing a number of lakes and ponds, a number of characteristics, including total surface area, were described. Surface area was further analyzed by elevation and fishery management class, Surface area was divided by elevation into acres below 1500 feet, acres between 1500 feet and 2000 feet, and acres above 2000 feet. Surface area was also broken down by ownership category.

3.3. INTEGRATION OF THE ANGLERS' SURVEY AND THE LAKE AND POND SURVEY

The Anglers' Survey and Ponded Water Survey used different methods for identifying particular water bodies and a mapping from one code to the other was necessary. Individual waters in the Ponded Waters Survey are identified by a watershed and pond number combination. For the Anglers' Survey, a water name and county was supplied by respondents.[4] However, NY DEC personnel cautioned against a one-to-one mapping of waters due to concern that anglers may not have accurately reported where they fished. Anglers may believe they are at one lake or pond when they are actually at a different lake. They may also use a name for the lake which is different from the official name for that lake. Also, there can be several lakes within a county with the same name. In these cases NY DEC personnel had to use their judgement, based on knowledge of popular fishing areas and species availability in these waters, in coding fishing locations. Since both the Gazatteer and the Ponded Waters Survey include identification of the 7-1/2 minute USGS quadrangie in which a water's outlet lies, the fishing locations from one survey to the other were mapped on the basis of 7-1/2 minute quadrangles. As a result, even if the fisherman gave the name of a nearby lake in error, his visit will still be mapped to the correct site as long as both lakes are in the same 7-1/2 minute quadrangle.

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4 .A code was created by the NY DEC for identifying waters in the Angler Survey which consisted of locating the water in the report, Characteristics of New York Lakes, Part 1 - Gazatteer of Lakes, Ponds and Reservoirs (Greeson and Robison, 1970). This was done by coding each water by a number where the first two digits indicated the page and the second two digits the line of the Gazatteer listing the water name and location. The result was a time consuming process where each lake or pond in the Anglers' Survey had to be be looked up by hand in the Gazatteer and matched to a lake with hopefully the same name and location in the Ponded Waters Survey.

3.4 SITE SELECTION

Site definition raised several issues. One of these issues has already been discussed, namely the problem of not being able to cross-reference waters between the Anglers' and Ponded Waters Surveys on a one-to-one basis. The use of 7-1/2 minute quadrangles may mitigate this problem. However, the use of 7-1/2 minute quadrangles poses other problems. Most importantly, the 7-1/2 minute quadrangle associated with any lake or pond refers to the quadrangle in which that water's outlet lies. For large bodies of water, this quadrangle can be several miles from where an angler actually fished. In other cases, a group of lakes may cross several quadrangle boundaries yet still exist in relatively close proximity with easy access from one to the other, making this group of lakes a reasonable candidate for a site (destination). There are few major roads within the Adirondacks, thus accessibility was another site determinant.

The issues mentioned above were considered when aggregating the individual 7-1/2 minute quadrangles into larger sites. The sites were constructed by grouping together as geographically homogeneous 7-1/2 minute quadrangles as was possible, given the best judgment of the project investigators. If the outlet of a lake was in one 7-1/2 minute quadrangle while the body of the lake was in a neighboring quadrangle, both quadrangles were included in the same site. Sites were also constructed to include groups of similar lakes, such as the Saranac Lakes. Another consideration was the highway system where quadrangles having a common access were included in the same site. From an empirical viewpoint, there have to be enough sites for sufficient degrees of freedom in the second step regression. A site specification resulting in 24 sites was ultimately decided upon (see Figure 3-1).